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West Europe Report

SCIENCE AND TECHNOLOGY

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AEROSPACE

FRG'S MBB/ERNO IS PRIME CONTRACTOR FOR EURECA PLATFORM

Munich-Ottobrunn MBB AKTUELL in German Jan 1985 p 5

[Article: "MBB/ERNO is Prime Contractor for EURECA"]

> [Text] Bremen/Ottobrunn--With the release of the EURECA [European Retrievable Carrier] development by the ESA [European Space Agency], the prime contractor MBB/ERNO has begun work on the latest large-scale project of the European space program. By 1 April 1985, the so-called PATP (preliminary authorization to proceed) is to be followed by the final contract signing. Initially the ESA program council and then its finance committee had approved the concept presented by MBB/ERNO and the financial scope with overall development costs in the magnitude of DM 547 million.

The task package with a volume of DM 260 million for the industrial consortium led by MBB/ERNO includes for the prime contractor the overall industrial management as well as the development of the AOCS (Attitude Orbiting Control System) and the propulsion unit OTA (Orbital Transfer Assembly), with which the platform is guided from the orbiter orbit into its position at an altitude of about 500 km and then back to the space shuttle when the mission is over. The technicians in Ottonbrunn are responsible for AOCS. The OTA is being developed and the overall system is being integrated in Bremen, where the project management is headquartered.

MBB/ERNO is simultaneously developing and constructing four essential payload elements: the PCF (Protein Crystallization Facility) and RITA (Radio Frequency Thrust Assembly) in Ottobrunn as well as the MFA (Multi Furnace Assembly) and HPT (High Precision Thermostat) in Bremen.

The PCF is an experimenting facility for the growing of large protein crystals under weightlessness, crystals that are to serve in further biochemical research. The fully automatic facility offers 12 independently controlled experiment chambers, in each of which a basic substance is made to react with salt and enzymes during a time period of 60 days.

RITA is an ion thruster which, as part of the technology research payload, is to make possible new knowledge about the behavior and operational capability of this new propulsion technology. Planned are 1,000 to 2,000 cycles during

a total of 2,000 hours of operation. The experimental propulsion unit produces a thrust of 5 to 10 mN through the electrostatic acceleration of xenon ions that are released in a high frequency field.

MFA involves a rectangular cylinder 64 cm by 64 cm by 90 cm with a capacity for 12 different melting furnaces. The payload element is being developed in Bremen and equipped and tested with all required subsystems such as data processing, power supply and cooling panel. This experimenting facility will be utilized by various European scientists, who will use it to continue experiments from the Texus programs and the Spacelab mission. Fully equipped, the unit weighs 180 kg. The volume of orders amounts to about DM 14 million.

A high-precision temperature device will be developed to give experimenters and users of the EURECA mission the opportunity to deepen the physical science findings of the Texus and Spacelab experiments during a long-term mission. In its geometric dimensions, the apparatus is a container as used in the Maus-Program. But for EURECA, the "barrel" will be completely reformed and reequipped. The lateral is not a standard end plate but a projecting rectangular cover that also functions as a radiator.

All payload elements will be integrated onto the experiment-carrying platform EURECA, which will be launched on its first mission at the beginning of 1988. The U.S. Space Shuttle is taking along the unmanned platform, which weighs about 3 tons, is equipped with 12 payloads, and is recoverable and therefore reusable. EURECA will be launched at an altitude of about 300 km and will then attain the mission position of 500 km with the OTA propulsion unit under ground control.

The EURECA project is an important step for the development of various systems of a permanent space station and the planned European contribution proceeding under the project name "Columbus." With and on EURECA, there will be testing of important and necessary technologies, engineering processes, and functions that will be required by a space station and applied by "Columbus."

9746
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DASSAULT OF FRANCE 'READY' FOR HERMES SHUTTLE

Paris L'USINE NOUVELLE in French 31 Jan 85 pp 24-25

[Interview with Bruno Revellin-Falcoz, General Technical Director of Dassault, by Marc Chabreuil; date and place not specified]

[Text] Without a dramatic turn of events at the end of the board meeting of the European Space Agency, which will finish its work this evening, the Europeans will, in 1997, have available only two of the three elements which would have guaranteed their space independence: the Ariane V rocket, as well as the habitable and automatic Columbus modules, which will be integrated into the large permanent station of NASA. Lacking will be a mini-shuttle capable of carrying raw materials, equipment, and engineers, and of bringing back to earth the finished products made in this station. Because the production of medicines, semiconductors, and special glasses in space form the stake of this vast program with an annual market estimated at Fr 420 billion as early as the end of the century thrown into the deal. Will the Americans agree to divide it by allowing Europe free access to their shuttle?

To escape from the monopoly of NASA in the field of space transport, France has proposed to her partners of ESA [European Space Agency] a plan for a space plane Hermes (Fr 12.3 billions over a dozen years). The Germans have said 'no', officially for budgetary reasons, but especially because they have always given priority to programs done in cooperation with the United States.

This German refusal must not be considered definite. The FRG could co-finance Hermes from now until 1988 on the condition that France adopt a willing attitude in pursuing these studies. The CNES [National Space Studies Center] which has established a project team, seems ready.

The manufacturers likely to become prime contractors include Aerospatiale and Avions Marcel Dassault-Breguet Aviation, who will thus make a noteworthy entry into the space race. Its general technical director, Bruno Revellin-Falcoz, explains, in an exclusive to L'Usine Nouvelle, the reasons for this decision and the technical strengths of Dassault in this matter..

[L'USINE NOUVELLE]: Why does Dassault wish to enter the space industry?

[Bruno Revellin-Falcoz]: All of the big aeronautical firms in the world are involved in outer space activities. Our am bitions in this area should not be a

surprise. We were simply biding our time, that is to say, waiting for an opportune niche. Here it is, with the mini-shuttle project, or, more exactly, the space airplane Hermes, proposed by CNES. This is an achievement to which we can bring a solid contribution thanks to our technological accomplishments and our aeronautical expertise. We can do this without involving significant industrial disruptions at the national level.

Question: What do a space airplane and a Mirage 2000 have in common?

Answer: Broadly, the Hermes shuttle and a Mirage 2000 are alike, since both have a delta wing - a specialty of Dassault - whose speeds of approach are practically the same. Hermes is a glider, and landing without an engine is a procedure for which our pilots train regularly, to simulate engine trouble. The definition of the aerodynamics for this phase of flight gives us no particular problem.

Many other developments made during our aeronautical programs are transferrable to a shuttle. For example, with a background in manned vehicles, we can provide safeguards for the crew: ejectable seats, 'high altitude' flying suits, breathing gas mixtures, pressurization, etc. We have made, in a Falcon 50 prototype, a complex ejection system for both pilots in case of trouble: a flame cut of a portion of the plane roof, automatic alignment of the seats under the opening, and ejection of the pilots. This system is adaptable to Hermes. It would allow saving a crew of four to six astronauts in case of trouble, even near the sun.

Likewise, the flight controls of high performance planes are, in principle, identical to those of the shuttle. We are the only aircraft company in the world who makes the entire assembly, because we wish to have the whole responsibility of the means of maneuvering, and the associated electronic calculators on which the security and quality of an apparatus depend.

The man-machine interfaces are also part of our daily work. We have integrated some very complex equipment in the Atlantic plane, in which the crew goes about its tasks which in certain cases may be related to those done aboard a shuttle.

Another of our strong points is in CAD with its Catia software as well as the calculation of structures and their optimization. Today we have information systems that simulate the behavior under stress of an entire plane as well as one detail, and describing the best performance/mass compromise. Having such tools is essential for a program like Hermes, because each gram of weight will be even more important than in aeronautics.

Question: Re-entry into the atmosphere at 7 km/s is not an everyday problem for a pilot!

Answer: The principal difficulty is in the knowledge of thermal fluxes during re-entry. We have carried out programs of theoretical aerodynamic calculations for many years. We have applied them to exact profiles of the American shuttle, and we have compared our theoretical results with the measures actually taken by NASA during the second shuttle flight: they are identical, from nose to tail of the apparatus, and for all hypersonic speeds up to Mach 28. We have accordingly used this method of calculation to define different configurations of the Hermes shuttle that we are currently studying.

There is the remaining problem of the materials of thermal protection for the space plane. In this area we are benefitting from the experience acquired from missiles. During the sixties we in fact developed and exported two-stage ballistic missiles which were satisfactory. But we must be realistic. This kind of program is not actually transferrable to Hermes: a missile nosecone gets very hot for a relatively short time and is not reusable, while the hot portions of Hermes will not exceed 1200°C during long time periods. More interesting is the study that we did for an American invitation to bid on an aerospace transporter. On this occasion, we improved thermal protection which underwent 100 simulated re-entries at 1200°C. This, even today, is a European first.

Still in the area of materials, some high-performance composites (fibers of boron and carbon) may be used for the 'cold structures' of Hermes. There also, we have acquired a head start with the ailerons of the Falcon 50 (first certification in the world of a plane using some essential parts made from composites and the rudder unit made from internal stiffeners on the Mirage 4000, not to mention the future structure of the ACX [European combat plane], where 25% of the mass will be made of composites. A record!

Question: Where are you in the preliminary project?

Answer: We have assembled a vertically-integrated crew directed by a project chief, which is supported by the horizontal specialized services of the venture (aerodynamic theory, flight qualities, equipment, safety, etc.). In other words, we are managing the Hermes preliminary project exactly as we handle a conventional airplane preliminary project. We have had that set-up for nearly two years, or a little before CNES gave us a pre-study contract. We might as well say, we have made a rather significant financial contribution from stockholders' equity. This includes some related programs such as space robotics (telemanipulators, etc.). This project is important for Dassault - it forms an excellent base for progress in engineering and in technology.

From now on, we are gaining experience in many areas which will be useful in developing Hermes. But much remains to be done before the first flight. All the more since we wish to integrate in this spacecraft the best that exists, in our shop and also in the shops of our partners and equipment suppliers.

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FRENCH PARTICIPATION IN, SPINOFFS FROM, EURECA PLATFORM

Paris ELECTRONIQUE ACTUALITES in French 22 Feb 85 p 18

[Article signed H.P.: "European Program Linked to Future Orbital Stations: Eureca Will be the Test Bench For New Space Systems"]

> [Text] The European space program for a recoverable unmanned platform, Eureca, was given the green light by the ESA (European Space Agency), and its industrial development stage started last December under the responsibility of a German prime contractor, MBB-Erno [Messerschmitt-Boelkow-Blohm/Erno]. This is an important component of the future space stations with which it will be linked, and it will constitute a test bench for new systems, for instance for robotics, orbital rendezvous, assembly or again inter-orbit telecommunications. France will contribute 17.31 percent of the program cost; the total cost was estimated at 206 million accounting units, at 1983 conditions.

Eureca is a program to which West Germany will make a majority contribution (53.66 percent). Next will come mainly Italy (17.33 percent) and France (17.31 percent), followed by 6 European countries. In the overall budget of the program, the industrial development stage will be allocated 115 million accounting units. Completion of the core of the Eureca payload will be ensured, financially, by an amount of 25.5 million accounting units. It will consist of five installations designed to carry out microgravity experiments. The platform, which will be launched by the U.S. shuttle in February 1988, will also include technological experiments of importance for future space-system developments.

French Participation

As far as the French industrial participation is concerned, MATRA [Mechanics, Aviation and Traction Company] will be responsible for the data-processing subsystem. This part of the equipment, which is not as complex as that of Spacelab, will use magnetic bubble memories supplied by SAGEM [General Electricity and Mechanics Applications Company]. MATRA will also be the prime contractor for the attitude-control system of the platform. Thomson-CSF will provide the S-band transponder, for which it will act as a subcontractor

to BTM [expansion unknown], which will be responsible for the remote-control and telemetry system. The platform will be equipped with new batteries produced by SAFT [Fixed and Traction Accumulators Company].

As is known, the Eureca platform will be reusable. It will be placed in orbit by the U.S. shuttle and will reach its operational orbit (500 km) on its own, for missions that will not exceed 6 months. It will then return to the rendezvous orbit where it will meet the U.S. space carrier that will bring it back to earth. Eureca will have a lifetime of 10 years and will complete 5 missions, starting in 1988.

Among the technological experiments scheduled for its first mission, Eureca will make it possible, in particular, to test in flight the main services and functions of an operational relay system for inter-orbit communications. This experiment, named IOC (Inter-Orbit Communication), estimated to cost 20 million accounting units, would involve the definition of procedures and equipment used to orient the antennas of the mobile and geostationary satellites. The geostationary satellite will be the Olympus satellite of the ESA, scheduled to be launched by Ariane in 1987 and which will be the forerunner of a family of satellites capable of carrying various telecommunication payloads, especially for direct TV broadcasting.

Inter-Orbit Communications on Spot

One result of the IOC experiment of ground-to-ground communications via two satellites could be that an IOC terminal would be carried by Spot 3 and 4, the earth observation satellites now developed by the CNES [National Center for Space Studies], MATRA and Thomson-CSF. As is known, at its Rome meeting on 31 January, the ESA council allocated some 50 million accounting units per year to advance a study of this type on an operational data-relay system, as well as manned or manned orbital-flight operations. Another experiment, called Rita and carried out by the FRG, will involve radio-frequency ion propulsion. According to the ESA, there could be an interesting market for this technology if the experiment yields conclusive results.

The study of the second generation of unmanned platforms derived from Eureca should be completed by the end of 1985. Built on the basis of the system that will be placed in orbit in February 1988, Eureca Mark II will remain in orbit and placed in the environment of space stations as a platform co-orbiting with them. Such platforms are included in the European Columbus project. The advantage of an unmanned platform compared to a manned station is that it can provide microgravity conditions unperturbed by human presence.

The calendar of the Eureca program places the Mark II-type platform around 1990. A permanent Eureca platform is scheduled for 5 years later, i.e. at the time when the U.S. orbital space station is expected to be completed. After the 2000's, the permanent Eureca platform should be part of the environment of the European manned orbital station. The EAS, which in Rome adopted a microgravity program centered on a more extensive use of Spacelab and Eureca, the ultimate goal being to use Columbus and the U.S. space station, is planning to spend 30 million accounting units in this field in 1985. This amount would be increased to 80 million accounting units per year starting in 1988, date of the launching of Eureca, and until 1992. Afterwards, microgravity financing is included in the financing of the Columbus program.

9294
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NEW BIOTECH FIRMS, FUNDS SPRING UP IN SWEDEN

Stockholm NY TEKNIK in Swedish 31 Jan 85 pp 34-35

[Article: "New Biotechnologists After Same Goals"]

[Text] Cancer research with so-called monoclonal antibodies and purification techniques for biochemicals.

These are two of the main areas in which the new biotechnology firms are investing millions.

Many of these millions are coming from Swedish businesses and are financed by Anders Wall, Tomas Fischer, and others.

There was something of an upswing in Swedish biotechnology in 1983. Researchers and well-known financiers joined forces to open new biotechnology firms. Biotechnology was also a high priority in the government's research proposal last year.

Now these firms have existed for more than 1 year. Several additional millions have been pumped in and it is now time to summarize where these investments have gone.

Clearly, these companies are still alive and conducting research in a number of different biotechnological fields, from protein synthesis, water purification, gene technology, and process development, to the cultivation of chanterelle mushrooms.

Experts believe that, in the long run, the biotech firms will be profitable. Everyone agrees, however, that the road to profitability will be a long one.

They also agree that specific products will take a long time to develop and that the Swedish biotech firms should develop products and concentrate their research in traditional areas of Swedish expertise.

Some examples of these areas are molecular genetics, medical microbiology, clinical bacteriology, and medicine in general.

Uniform Industry

This is precisely the field in which the industry is concentrating its efforts. But their activities are extremely similar.

All four of the largest new biotech firms are involved in the production of monoclonal antibodies, for example.

Shipowner Sten A. Olsson's biotech firm in Goteborg, Stena Diagnostics, for example, has concentrated all its efforts on the production of monoclonal antibodies, while companies such as Skandigen are keeping their options open by buying into other firms that produce antibodies.

It is no coincidence that all this interest in concentrated in the same area.

Homing Missiles

The possibility of producing these biological "homing missiles"--the so-called hybrid technology--is seen as one of the most important medical innovations of today. The 1984 winners of the Nobel Prize in the field of medicine, Georg Kohler and Cesar Milstein, for example, received the prize for their discoveries in hybrid technology.

In addition, the production of monoclonal antibodies is one biotechnical activity that is producing profits even today.

In most other areas of biotechnical research and development, work is still at the laboratory level.

In the area of hybrid DNA technology, for example, there are still only three finished commercial products, namely insulin, interferon, and growth hormone.

"Monoclonal antibodies are just as important to biotechnology as the chip is to electronics," said Leif Ek, executive vice-president of Skandigen.

"These new tools will help us find new ways to diagnose and treat illnesses, especially in cancer research."

Object Of Investment

In addition to hybrid technology, the companies have invested in the purification and separation of biological products.

BioCarb in Scania--the object of investments by Anders Wall and Erik Penser--is concentrating primarily on carbohydrate research.

By producing biologically active carbohydrates artificially and then introducing them into the body, it is possible to block bacteria so that they cannot take hold of cells.

In addition to this research and research on monoclonal antibodies, however, the company also has a large joint project with Perstorpskoncernen.

This project involves the purification of hormones, enzymes, and toxic proteins.

It is hoped that this project will result in such practical applications as better and purer vaccines, such as the vaccine against whooping cough.

Skandigen, which is a very internationally oriented company, owns 25 percent of the English biotech firm Fermentech Ltd.

This company has just developed a protein, called protein A, that is used to purify monoclonal antibodies.

While companies such as BioCarb, Bioinvent, and other newer companies are working on new projects, more and more biotech firms are springing up like mushrooms.

Even More Companies

In late 1984 several researchers in Umea started two biotech firms, called Cyntec and Biopool.

Both companies produce proteins and the latter company is owned in part by Skandigen.

In Uppsala a new company is developing measuring instruments for biomolecules and in Helsingborg, BCP Biotecnics is working with food technology.

This development is similar to what happened in the United States about 10 years ago, but on a smaller scale.

Biotechnology firms sprang up overnight at that time. Many failed but others, such as Genentech, became extremely large.

Typical of the Swedish companies is that they are researcher-owned, to a great extent, and major financial interests have placed risk capital at their disposal.

9336
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COMMERCIAL PROFITS, STATE FUNDING FOR BIOTECH UP IN FRG

Duesseldorf VDI NACHRICHTEN in German 15 Feb 85 p 6

[Article by B. Eusemann: "To Large Profits With Little Animals: Billions in Sales With Biotechnologies--Gene Technology Covers Just a Small Area"]

> [Excerpts] While some are vigorously debating what one should do in the first place and to what limits one should be permitted to go, others have long since been energetically involved in converting the increase in knowledge in the most varied areas of biotechnology into marketable products. Or, as Prof Dr R. Sammet, chairman of the board of Hoechst, recently said in Frankfurt at a twilight drink with the Association of the Chemical Industry: "Biotechnology becomes reality in sales."

The great extent to which products from and associated with the area of the "green revolution" have already gained weight of their own is also shown in the courting by fair organizers. Three large exhibitions on this theme are coming up this year alone. Achema leads things off in June, where one of the focal points in the management of the exhibition and in the conference reports is in biotechnology. And in October, BioTechnika '85 (First International Congress plus a fair for biotechnology) in Hanover and Biotec '85 (First International Conference with an exhibition for biotechnology and gene technology) in Duesseldorf are competing with one another.

But the situation in Europe is not quite as gloomy as is widely lamented. In Great Britain, numerous venture capital firms are active along with the large chemical concerns. All of the large firms of the FRG are frolicking in this promising area: Bayer and Hoechst, the two Boehringers and BASF, Schering and Degussa and about 20 other companies.

But state installations and ministries were also quite early in reacting to the new development. Thus as early as 1974, for example, the Federal Ministry for Research and Technology took iniatives here that were triggered by a report of Dechema (German Society for Chemical Instrumentation).

In the opinion of many representatives of industry, to be sure, the absolute figures for research promotion are still too small. Thus in 1982, the state spent DM 84 million to promote biotechnology; that corresponded to about 0.3

percent of the budget of the Ministry for Research and Technology. Since then, the amounts have increased here as well.

According to a report by the German Research Association in October of last year, about DM 300 million are spent for biotechnological research. In addition, the previously mentioned distribution of emphasis between classical and up-to-date technology can be seen here as well: only DM 30 million of that amount are for projects in the area of gene technology. In 1982, to be sure, this share was just DM 17 million.

Finally, very close cooperation between industrial enterprises and research installations is noted here. Besides their own research, almost all large chemical firms also practice close cooperation with the most varied university institutes and other institutions. Increasingly, this trend is not everywhere meeting with unanimous approval.

9746
CSO: 3698/431

BRIEFS

SWEDEN'S VOLVO BUYS PHARMACIA AB--According to reports from Sweden, AB Volvo has acquired a majority participation in Pharmacia AB. With 3.2 million shares, it is now the largest shareholder in the pharmaceutics and biotechnology company. This number of shares corresponds to 6.4 percent of the capital stock and 26.6 percent of the voting rights. It is said that Volvo paid more than 650 million kronor for this transaction, about 10 percent over the market price. Volvo supposedly acquired the stock from foundations that are linked with the founders of Pharmacia. Volvo has already indirectly obtained a participation in Pharmacia through the investment company AB Custos, which held 2 percent of the shares and 4.7 percent of the voting rights at the end of 1983. With Volvo's commitment, the company is making further advances into the biotechnology area. It is said that it now owns 22 percent of AB Cardo, which is involved in the sugar, seed and biotechnology sectors. Its share of KabiGen AB, active in the biotechnology area, is estimated to be at least 15 percent. Volvo holds about 33 percent of Sonesson AB, which recently acquired the pharmaceutical companies AB Leo and AB Ferrosan. Sonesson also owns 57 percent of Gambro AB, which manufactures medical instruments. [Text] [Duesseldorf EUROPA CHEMIE in German 15 Feb 85 p 72] 9746

EEC 5-YEAR FUNDING--As part of the multiannual program of research in the field of biotechnology for the EEC, which the Council of Ministers approved on 19 December, the Brussels Commission issued an invitation to submit research proposals--coming if possible from "two or several laboratories located in different states" and/or "implying an integrated participation of public laboratories and the industry"--for the 5-year program funded for up to 55 million ECUs [European Currency Units] (about FF 375 million) (JOURNAL OFFICIEL DES COMMUNAUTES EUROPEENNES dated 16 February 1985, page 4). Subject to the final decision of the Council of Ministers, operations "in the contextual field" will involve essentially bio-data processing and collections of biotic materials, and those in the field of basic biotechnology will involve "the development of biomolecular engineering for certain agricultural and industrial applications, the development or improvement of new technologies for the exploitation of cell and tissue cultures," as well as the development of "new methods to assess the risks that could be associated with modern biotechnology." For its part, the Academic Committee on the Applications of Science (CADAS) of the French Academy of Sciences, which has been operating for two years, having noted that "the reality and quality of the interface between chemistry and biology are not at the level that could be desired (in France) compared with examples from abroad," suggested to launch in the near future a five-year plan to train highly qualified chemists in biochemistry and biology in order, among other things, to ensure "the necessary symbiosis between universities and the industrial sector." [Text] [Paris CHIMIE ACTUALITES in French 25 Feb 85 p 4] 9294

CSO: 3698/437

CIVIL AVIATION

AIRBUS INDUSTRIE PROCEDURES FOR CHOOSING A-320 SUPPLIERS

Paris L'USINE TERTIEL in French Feb 85 pp 52-56

[Article by Alain Barbanel]

[Text] A few weeks ago, there was the "fabulous Pan Am contract." Pan American World Airways, one of the world's leading airline companies, bought 44 Airbuses, 16 of them A-320's, the latest addition to the family. A contract without precedent in the aeronautical industry: $1 billion. To ensure the initial deliveries of the A-320, which are to begin in 1987, the heads of Airbus Industrie went right to work. At the Toulouse office, which is the European consortium's prime contracting headquarters, the choice of equipment manufacturers who will take part in the Airbus A-320 program is currently a priority.

More than ever, for this cutting-edge industry, procurement policy must be exemplary. "The technology of the product is so advanced that 'almost' is not good enough," emphasizes Roger Chanut, assistant to the general manager and head of international cooperation. "Here, equipment, materials and supplies obey strict and clearly defined rules, and are our permanent battle steed." Although the avionics undoubtedly remain the responsibility of Thomson, and the landing gear that of the Messier-Dowty team (a British one), the competition is open for all the other parts of the plane. In all, close to 600 subcontractors will be chosen for the definitive construction of the plane.

To carry out the final selection, the procurement headquarters of Airbus Industrie makes full use of the marketing techniques that have been developed by its purchasing offices, financial services and production departments.

The starting point of operations: Definition of needs. At this stage, the European dimension of the Airbus Industrie consortium--which, of course, involves French industries, but also British, German and Spanish ones--must be taken into account. To simplify the process and distribute responsibilities, each partner evaluates its own needs as a function of the technological specificities of its work program.

A "Yalta-style partitioning," of sorts, it enables each one to manage his own supply program in harmony with the recommendations of the Toulouse technicians. These recommendations have to do in particular with the steps to be followed in the evaluation of needs, under the direction of the design bureau. Buyers and technicians work closely together to determine the technical feasibility criteria of a piece of equipment produced by a supplier.

The buyer fulfills an essential role. With his perfect knowledge of the suppliers' market, he is in a position to give his opinion to the technicians as to what is realizable and what is less so. His viewpoint helps to temper the technical demands of the specialist, which at times can be excessive. This joint product-and-market approach is the cornerstone of the defining of the needs of each partner.

"Where the construction of the A-320--a revolutionary plane--is concerned," remarks Roger Chanut, "we ask our purchasing partners to forget the past with their traditional suppliers so that we can work on entirely new bases." In practice, however, only equipment makers who have a sufficiently proven know-how can afford to respond to RFB's [request(s) for bids]. The natural selection process eliminates those who do not have the technical competence and sufficiently sophisticated production tooling to satisfy the Draconian requirements of the builder.

Once the needs have been evaluated, the specifications are drawn up, still under the control of the Toulouse design bureau. These specifications are then distributed in the form of RFB's to some 30 different suppliers for each component. The suppliers are chosen by the partner concerned, in accordance with essentially technical criteria.

Next comes the decisive stage in the sorting out of the responses. Here again it is up to the partner to judge the reliability of the bids and to classify them by order of preference. The partner forwards to Airbus Industrie a report on the bids of choice with supporting comments. "At this stage, our role consists of adding supplementary information that is not present in the report. For this, we consult the airline companies, which give us, for example, their opinion of the degree of reliability of the supplier's post-sale service; and we query the other partners, who may also be able to share with us any experiences they may have had with this or that supplier," adds Roger Chanut.

An Imperative: Say It in Dollars

A former pilot, with more than 1,000 flying hours to his credit, Roger Chanut is well-positioned to evaluate, on the basis of knowledgeability, the opinions received. "At Airbus Industrie, we think a good buyer is first of all a person who is fully qualified to sort out the information provided and draw from it conclusions affecting the long-term supply policy. By sharing views, by cross-checking experiences, we limit errors of choice, which can have adverse effects on the image of our company."

Second stage: When the supplier's technical specifications fulfill all the conditions and have the unanimous agreement of the partners, the price has then to be negotiated. Airbus Industrie does not seek systematically to strangulate its equipment supplier by imposing bottom prices on him. On the contrary, the builder is prepared to pay the cost of the supplier's know-how, on condition, however, that the latter undertakes to abide by certain rules. For example, in order to reduce the risks of fluctuations in the cost of equipment, Airbus Industrie requires that its supplier state his rates in dollars, taking into account fluctuations in exchange rates over several years. "That is the sine qua non condition to be able to work with us," says Roger Chanut. "The explanation is simple: Since we sell our planes in dollars, we must perforce align our operations on that currency, so as to be able to project our actual costs over the long term." Where a major equipment supplier is concerned, Airbus Industrie requires a fixed price schedule covering 10, and even 15, years.

For the suppliers, although they recognize this to be a legitimate precaution, it is a bitter pill to swallow. At SFENA [French Air-Navigation Euipment Company], which will be supplying the A-320's fly-by-wire controls and automatic flight-control systems, Jean-Luc Sicre, head of the Commercial Aviation Department's Marketing Division, and Daniel Busson, head of the Central Procurement Office, were asked to come up with a bracketed price range over a 5-year period. "True, committing oneself to a frozen price covering several years is a big risk for the enterprise," says Jean-Luc Sicre. "But on the other hand, it enables us to hone our procurement and planning methods with our own suppliers."

All evidence bears out the fact that being a supplier to Airbus Industrie is not something one can improvise. Even with a signed contract in one's pocket, things are far from being perfect. The equipment supplier must be prepared to meet all possible tests of good will under the constant pressure the buyer will be exerting. For example, delivery dates must be met imperatively.

Rising just a few hundred meters from Airbus Industrie's offices are Aerospatiale's gigantic shops, where the future A-320's will be assembled. Here, every day, 200 orders are issued to different suppliers, for components ranging from the tiniest screw, through the different parts of the wing, and to the elements of the cockpit. The biggest items are brought to Aerospatiale by Super-Guppies, those whale-backed planes especially designed to transport plane sections originating in the four corners of Europe.

A Supply Interruption Out of the Question

"You see this assembly line?" asks pointedly Michel Bianco, of Airbus Industrie's Production Department. "Well, if a single item were to be lacking to complete this section of the wing, the entire manufacturing process would come to a halt. And when you consider that it takes 36 months to build a plane, you can imagine the cost a single day's stoppage represents."

Like many of his colleagues, Michel Bianco has aeronautics in his blood. After graduating from a national school of engineering, he went to work for Aerospatiale on certification studies, and became head of subcontracting procurement, in which capacity he was especially charged with supervising the flow of supplies on a day-to-day basis. Today, he is empowered at Airbus Industrie to negotiate modification costs with the different partners. As a result of his having required that they be applied to the letter, he has the knowledge at his fingertips of the different rules that govern the enterprise's procurement policy.

"Once the list of suppliers has been definitively drawn up," continues Michel Bianco, "an information processing program lays out batches of orders covering several months, in such a way as to spread out the subcontractors' workload. A veritable countdown begins. On D Day, the plane is delivered to the airline." For standard equipment--the "hardware," in aeronautical jargon--procurement officers, who are permanently present on the site--that is, in the shop--are responsible for ensuring the proper flow of supplies by types of equipment. They are in permanent liaison with the suppliers, pressuring them to deliver the ordered equipment on the contracted delivery dates.

An On-Site Liaison Office is Necessary

The partnership concept plays an essential role in the orderly functioning of the organization. In reality, the term that is incessantly voiced by the various Airbus Industrie officials is that of a "marriage" between the buyer and his supplier. "Although we are prepared to play the game by giving them a maximum of information to enable them to satisfy our needs in a timely manner," says Roger Chanut, "in exchange, we demand that the clauses of the wedding contract be respected to the fullest extent possible."

The fact is that, although Airbus Industrie militates in favor of a lifetime marriage, particularly for major "custom-made" items, such as automatic pilots, from the standpoint of the supplier the risk of divorce is not to be ignored. In this respect, Airbus Industrie, once again, takes every precaution, seeking at all costs to avoid monopoly situations with regard to certain suppliers.

"The perenniality of the marriage can at all times be put to question," says Roger Chanut. The subcontractor must consistently give of his best, as regards both delivery dates and the quality of his products, as well as with regard to his ability to manage rapidly the improvements that must be made to certain materiel." Airbus Industrie also prefers to prevent than to remedy, by diversifying it sources of supply.

Clearly, the strategic distribution of its procurement is a constant concern of the builder. "For us," says Michel Bianco, for his part, "the notion of a marriage must above all not engender a phenomenon of habit. Our suppliers must constantly redouble their efforts, not only as to the quality of their products but also as to the services they provide, to seduce us and merit our fidelity."

Airbus Industrie has no scruples about renewing its RFB's to build up its list of suppliers. This wielding of potential competition acts as a veritable sword of Damocles over the head of the "spouse" in the event of a failure. The stakes are big, and suppliers can be depended on to submit to the rules of the game. As for the others, there is no hope on the horizon! Two examples will suffice to perfectly illustrate these efforts. In the mock-up hall, where the different elements of the Airbus A-320 are displayed as full-scale models, the officials of the airline companies come to choose with their own eyes the interior appointments of the plane: Seats, galleys, carpets, decorations, etc.

Jean-Marie Hohl, "orchestra leader" of this showroom, is a fervent militant for wielding the sword of competition. "To multiply our sources of supply," he explains, "we asked the suppliers of seats who had responded favorably to our RFB to equip our mock-ups free of charge so that we could provide our clients with a complete sample of our sources. This also provides an opportunity to remind each subcontractor that a monopoly situation is nonexistent." This is not to say that the furnishing of these components free of charge does not represent a tying down of considerablesums of capital by the supplier, which operates to exclude straightaway all those who lack the necessary resources.

In the shops, the outlay in order to supply is also colossal. Specifically, subcontractors are required to install on the premises a liaison office to organize their production management.

Thus, Sperry takes delivery at Aerospatiale of everything shipped to it from the United States for the project, and dispatches it in accordance with manufacturing schedules. Nevertheless, to alleviate these handicaps, Airbus Industrie strongly encourages its partners to join forces as consortiums, which facilitates a more competitive pricing policy and enhances the effectiveness with which operations can be monitored. To date, for the Airbus A-320, two consortiums have been chosen: One supplies the electric-power generation; the other, the automatic flight controls. They bring together SFENA, Sperry and a German firm. Says Roger Chanut: "The European equipment industry suffers from its dispersion--which complicates our procurement policy."

In short, there cannot be a happy marriage without a balanced ratio of forces. This viewpoint is confirmed in the A-320 procurement policy. But as of now, this expression of faith involves only two-thirds of the equipment manufacturers chosen and already confirmed. As for the others, they have not as yet completed the trying course of mere engagement vows.

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BACKGROUND ON NEW AIRBUS INDUSTRIE CHIEF JEAN PIERSON

Paris L'USINE NOUVELLE in French 14 Feb 85 p 14

[Article by Patrick Piernaz]

[Text] An engineer will be replacing an "enarque" [graduate of the Ecole Nationale d'Administration] as the head of Airbus Industrie--a summary that fails to tell the whole story: Will the technicians be taking the upper hand over the "financists" at the helm of the European consortium?

Assuredly not. First of all, because Jean Pierson is not solely a brilliant engineer; and secondly, because Bernard Lathiere was not solely a "financist." Nevertheless: The style will change. Bernard Lathiere was a supersalesman who ram-battered down the doors of the airline companies--with successes that are well known, but also giving rise at times to gnashings of teeth by the German and British partners of the consortium.

Jean Pierson, 44, a "SUP aero" [term unfamiliar], does not have the same profile. He is first of all a product of the milieu. Having at the age of 23 joined Sud Aviation, which became Aerospatiale in 1970, this man, who has a Northern name but who was born in Bizerte, Tunisia, found his geographical equilibrium at Toulouse, where he had a brilliant--indeed, a dazzling--career that led to his becoming, at 43, the head of Aerospatiale's "Planes" Division.

Behind this success lies hidden a genuine negotiating and organizing talent which undoubtedly explains his forthcoming designation as head of the European consortium. Jean Pierson, after having been chief of production of the Concorde, succeeded in organizing Airbus's production and the rise of its industrial output, which has never been found at fault. In that capacity, he was able to compel the respect of the Germans as well as preserve the esteem of the British, with whom he has been on intimate terms since the Concorde's takeoff. In this regard, he also told L'USINE NOUVELLE several months ago that he "had always very much appreciated the richness of his work sessions with the British aircraft manufacturers, despite the vicissitudes of the Concorde program."

This attests to a capacity for dialogue that is going to be indispensable to him in his handling of the consortium's new top management structure. To

date, Airbus Industrie has boiled down to two key men, two Frenchmen: Bernard Lathiere and Roger Beteille. The latter is a legendary figure who has always intrigued the Americans--Roger Beteille's white tie is almost as famous Marcel Dassault's scarf... It is Roger Beteille who will be filling in temporarily as chief until the arrival of Jean Pierson.

While Bernard Lathiere was the boss and marketer, Roger Beteille was the industrialist who made the wheels of the company turn. The simultaneous departure of the two men provides the opportunity the Germans have been awaiting to put to issue the company's organizational structure. Although tolerable 10 years ago, when the German aeronautical industry was insignificant, this French management tandem is no longer acceptable to a partner that has completed its industrial recovery and that owns the same number of shares in the consortium as France does: 37.9 percent each owned by Aerospatiale and MBB [Messerschmitt-Bolkow-Blohm], versus 20 percent by the British and 4.2 percent by Spain.

Unquestionably, France's influence will diminish in the management team: Roger Beteille will be replaced by a German, Johann Schaeffler, presently the manager of MBB's "Planes" Division, who will head Airbus Industrie's technical and industrial activities. The team will be completed by a Britisher in finance and a Frenchman, Pierre Pailleret, in marketing. However, one wonders: Will political logic necessarily go along with industrial efficiency? The risk of incurring the paralysis of a European structure that is already a slow-moving one is real. From a technical standpoint, this is certainly the case. The enterprise operates on the basis of meetings. Even Aerospatiale admits that it is difficult to rival Boeing's flexibility, which is able to produce a plane 18 months earlier than Airbus.

From a financial standpoint, progress has still to be made. Bernard Lathiere's "shouts" are still remembered, powerless, as he was, to coordinate the different export financing agencies for the granting of credits of longer duration to the client airline companies.

Then there is marketing. Its boss, Pierre Pailleret, 40, one of the negotiators of the Pan Am contract, is confident: "The most important thing is to not upset the teams and to preserve a feeling of confidence among the partners." Bernard Lathiere's brilliant second knows, however, that he still has a long road ahead. "First of all," he says, there are still doors that have to be battered down: We have 50 client airlines; we still have 200 to convince!"

Above all, he must still win the second-hand-plane battle on the other side of the Atlantic. For, in addition to the new A-320, Airbus Industrie also wants to penetrate the American market via the "little" door. It wants to sell second-hand A-300's, but also Boeings, to the small airlines, competing with Boeing, which has put in place a "second-hand sales" structure to provide an outlet for the planes it takes in as trade-ins: Lockheeds, Douglases, Boeings and Airbuses. The battle looms fierce. Jean Pierson cannot afford to lose it...

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MBB OF FRG TO DEVELOP HELICOPTER AIRFRAME MADE OF COMPOSITES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German
11 Apr 85 p 7

[Article: "Helicopter Airframe From Composite Material: MBB: More Efficient Production With Large Modules and Higher Cost Effectiveness"]

[Text] Frankfurt--The enterprise Messerschmitt-Boelkow-Blohm GmbH, Munich-Ottobrunn, wants to develop a complete helicopter airframe out of fiber composite. As the enterprise reports in its internal magazine MBB AKTUELL (March 1985), a first flight of a BK-117 synthetic helicopter is foreseen for 1988. As the enterprise sees it, the knowledge gained from this research program should later be applied in the development of larger transport helicopters. From the use of fiber composites, MBB is expecting a reduction in weight of about 20 percent as opposed to conventional metal structures and the saving of up to 50 percent of the parts and components still needed today. The research program that has now been made public is to show how far one can go in practice. One thereby also wants to acquire knowledge for the proper use of materials in this new type of construction. Not least among the goals of the project is that of simplifying the maintenance and repair of helicopters and thus of raising their cost effectiveness.

As the enterprise further explains, fiber composites are already being used for all nonstressed structural parts and also for the rotor blades. Thus the doors, rear doors, maintenance access doors, the rear and engine fairings as well as the windows are already made essentially of such materials. The horizontal tail unit was the first primary structural part to be constructed of composites. But other primary structures such as the airframe floor, side shells and cockpit shells are constructed using aluminum and are to be replaced with fiber composites in the research program that has now been announced. Accordingly, the synthetic airframe will be about 80 percent synthetic material reinforced with carbon fiber. For the rest, kevlar is foreseen. Kevlar is being considered above all for the outside fabric, reports MBB. All technical components, the dynamic system, rear boom, and other items would be taken over from the standard BK-117 helicopter for the research work.

In the view of MBB, the use of fiber composites in the production of helicopters could be the most advantageous, because one could work with only a few large modules in production and outfitting. Under the metal construction usual today, installations such as fuel tanks and electronics cannot be

undertaken until the helicopter has been completely built, for the individual components must be joined using innumerable rivets and are not load bearing as individual parts.

Other manufacturers are also working on the development of helicopters made of composites. Thus the American company Sikorsky Aircraft reports that its military ACAP (Advanced Composite Airframe Program) helicopter, which has been in development since 1979 and which has a pure composite airframe, will now be flight tested. It reports a weight saving of 24 percent at the same time that costs were 25 percent lower, whereby the conditions of the U.S. Army were even surpassed. As Sikorsky says, the company will now develop a rotor system composed completely of composite material. It is to be expected that customer demands will rise in regard to maximum speed, payload, reliability and maintainability as well as endurance with a simultaneous reduction in vibration. One can meet these requirements only through the use of simpler rotor systems made of composite materials. Sikorsky sees substantial chances here: the casting of rotor blades of composite material makes possible considerably more complex geometric forms than in the case of traditional blades with metal shafts. In addition, the rotor head will become substantially lighter. Initial flight tests for the composite head are planned for this summer. Sikorsky is also working on the development of a main rotor without bearings.

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COMPUTERS

DFVLR, GMD, ERLANGEN, OTHERS WORK ON FRG SUPERCOMPUTER

Munich INDUSTRIEMAGAZIN in German 15 Jan 85 pp 80-84

[Article: "The Formula-One Computers"]

> [Excerpts] More and more, supercomputers--maximum-performance computers that have heretofore been reserved for science--are becoming industry's helper in innovation. With a new concept, German developers want to realize an even faster giant computer.

The name sounds like unbeatable maximum performance: "Suprenum" is what the initiators have christened the ambitious project, the most powerful computer ever to be built in Germany. Experts estimate the costs until it is marketable to be at least DM 50 million.

In a few weeks, the DM 2.5 million project definition phase, which has continued for 1 year, will come to an end. At that time, Federal Research Minister Heinz Riesenhuber expects the joint project proposal of the participating research institutes and industrial enterprises to be on his agency desk. He must then decide whether or not the adventure is to be pursued seriously, for nothing happens without the Federal Government as the granter of subsidies.

"Suprenum" stands for "supercomputer for numerical applications"--numbers-devouring machines of almost exclusively American origin, however, that are already carrying out extensive but per se largely uniform scientific-technical calculations at a rapid pace in large research centers.

Growth market. Eight such computing champions are working in the FRG: the most powerful, a Cray X-MP, at the nuclear research installation in Juelich; and four more Cray models at the Max Planck Institute for Plasma Physics in Garching near Munich, at the branch of the German Research and Development Institute for Air and Space Travel (DFVLR) in Bavaria's Oberpfaffenhofen, at the University of Stuttgart and at the Konrad Zuse Center in Berlin, which is supported by the Free University and the Technical University.

The Technical University of Karlsruhe, the University of Bochum, and the petroleum prospecting company Prakla-Seismos GmbH in Hanover decided on the

Cyber 205 of the U.S. competitor Control Data; the Max Planck Institute for Meteorology in Hamburg has ordered a system of this type.

German plans. The planned cooperative project goes beyond mere academic research. "We want to tie together the efforts that have been made heretofore at various places by leading computer-science and mathematics institutes, by users of supercomputers and also by German computer manufacturers and we want to develop a marketable product," declares Trottenberg.

The German way is radically different from the heretofore prevailing development philosophy of pushing and making better use of the hardware technology that has already been chosen.

The "Suprenum" concept follows the apparent trend toward computer specialization. It proceeds from a certain group of application problems that have one thing in common: they can all be resolved with the aid of the so-called multiple-grid principle, a computation method (algorithm) that even with traditional supercomputers leads to the goal much faster than other approaches.

If a suitably designed computer is developed for this purpose, then the method's speed advantage can be increased even further. Precisely that is the thought of the initiators of "Suprenum," especially Trottenberg, who has long been involved with multiple-grid methods at the Institute for Methodical Basic Data of the state Society for Mathematics and Data Processing mbH in Sankt Augustin near Bonn.

Computer architecture amounts to a "massive parallel processing" in a multitude of processors. One thereby resorts to concepts already developed at the Technical University in Berlin and the University of Erlangen-Nuremberg. In the first project phase, by 1988 at the latest, a prototype is to be developed in the 200 mega-flop range usual today with 64 to 1,000, probably 500, parallel processors. Later, with the know-how thus gained, it is to be expanded to the maximum-capacity version in the giga (billions)-flop dimension. The user side has heretofore been represented in the project mainly by the nuclear research installation at Juelich and by aerodynamicists and climate researchers of the DFVLR, and industry has been represented by the firms Krupp-Atlas Elektronik in Bremen and Stollman GmbH in Hamburg.

Krupp-Atlas wants to be involved, because "we have always been very interested in innovations in advanced electronics and we believe that the know-how gained thereby will benefit normal operations," explains Herwig Meyerhof, chief of the development computer hardware and basic software. As a manufacturer of process control computers and as the custom tailor of large-capacity systems based upon them, the Bremen firm has experience in parallel processing. "Our newest computer is composed of 8 to 10 parallel processors." Krupp-Atlas is also "very active in the area of simulation technology."

In both areas, Meyerhoff sees opportunities for the planned "Suprenum" computer. For training purposes, possible failures in nuclear power plants can be simulated "precisely with all special features and in real time." It would also be conceivable to support the process control of chemical installations or

nuclear reactors through the more rapid detection and correction of errors. To do that, however, it would be necessary to increase capacity by a factor of 100 relative to today's supercomputers. According to Meyerhoff, "the more and more nearly perfect imitation of the artificial scenery" for flight or navigation simulation requires "a tremendous amount of computations" that could be handled better than with today's special computers of Krupp-Atlas.

Although designed more for specialization than a Cray machine, for example, "Suprenum" is supposed to cover a number of important scientific and industrial applications. The multiple-grid methodology makes it possible: it can be applied for partial differential equations--the mathematical backbone of physics--as well as for so-called finite-element calculations in statics and design.

For Werner Zucker, management member of the system house Stollman GmbH, the opportunities for "Suprenum" are by no means limited to the development of an advanced model: "The concept can be scaled down to a super-minicomputer, to a superrapid image-processing work station for computer-aided design and manufacture (CAD/CAM) or for stress simulations in a construction statics office." Stollman has already taken a first step in this direction: the 80-employee firm developed for Triumph-Adler a workplace computer with distributed processors, TA 1900, which is also marketed under the label "Maja."

As opposed to the maximum-capacity model of the first step, which, after its realization, would probably be brought to the customer in direct marketing, Zucker envisions for the superminis the "sale of blueprints" to domestic manufacturers of the corresponding application systems.

Obstacles

Until then--a "Suprenum" prototype would hardly be ready before the beginning of 1988--there are still some obstacles to overcome. Since the material costs alone for the prototype are estimated at DM 20 million, the firms would be carrying a large residual risk, despite a 50-percent subsidy by the Federal Ministry for Research and Technology [BMFT]. A possible solution would be that the BMFT provide a credit for it to be repaid through the sale of the prototype to a pilot customer. Even more crucial is whether the project management is able to bring together the forces: numerical experts and computer architects, hardware development and software specialists must work together closely. How "Suprenum" is accepted by users depends not least upon a software connection to the world of the Fortran programming language.

A failure of the project would have fatal consequences: according to a branch expert, there is already a "certain danger that the Americans will not deliver any more supercomputers because of a striving for military security." In two cases, there were difficulties with U.S. export approvals. The training of new engineers in this area would also be crippled.

"With the project," stresses Stollmann manager Zucker, "the decision will stand or fall as to whether we in Germany want to continue in computer architecture."

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GMD OF FRG ANNOUNCES 1985 R&D BUDGET, PROJECTS

Duesseldorf VDI NACHRICHTEN in German 1 Mar 85 p 4

[Article by G.H. Altenmueller: "Expert Systems to Be Applied: Researchers Want to Translate Artificial Intelligence Into Action"]

[Text] The Society for Mathematics and Data Processing (GMD), Sankt Augustin, has now, 2 years after its reorganization, been able to present a research and development program for 1985 with a clear orientation toward the future and applications. Prof Dr Norbert Szyperski, GMD chairman of the board, takes seriously the "relative autonomy" of the large-scale research installation that he manages. In its scientific-technical work--developments in information technology for organizations--it relies on its own methodical basic research but with more relation to practical applications than at the universities.

In the stressful field between science, manufacturers and users, the GDM wants to pursue long-term goals and provide neutral advice. Organizationally as well, the result is an ever-closer cooperation with universities as well as cooperative projects with industrial enterprises. In presenting the research program, Professor Szyperski was of the opinion that this cooperation would become continually easier in response to the Japanese challenge. And industry's involvement in information technology has climbed out of the "valley floor."

Information Technology As a School Subject?

In its research and development program, the GMD considers that it is obligated to the human and social aspects of the utilization of information technology and that it serves the general public. It therefore assigns great weight to open grids not restricted by producer or firm limits and to transferable software as well as the earliest-possible participation of users and their staffs in the development of information systems, open information markets, and help for smaller enterprises. As important specific goals, Szyperski named information security technology that will guarantee that the computer "does not do what is not intended and that the responsibility for what is done is traced back to natural persons only" as well as progress in the area of information law and data privacy. The GMD is especially involved in the introduction of

information technology into schools and it wants to establish the objective basis for the discussion of interests through forums for representatives of trade unions, enterprises and user organizations. Centers for information technology at community entities are to help enlighten borad groups of employees and the population. The 1985 GMD budget amounts to DM84 million; about DM10 million are its own income from cooperation with firms, whereas the Federal Government and the Land North Rhine-Westphalia are participating in the ratio nine to one in the state allowances. The GMD employs about 800 people in its three research and two service institutes.

In basic research, the GMD relies on competence that is recognized worldwide. At the Institute for Methodical Bases, the Petri grids--named after one of its three directors--for the graphic presentation of complex facts are being further developed. The goal for 1985 is graphic computer support in designing such grids. For the multiple-grid methodology developed in the GMD, a special computer is being developed, whose main computer breaks a task down into subtasks and then distributes these to "subordinate computers," collects their results and uses them to work out the final result. Combustion processes in engine cylinders, aircraft flow behavior in the supersonic range, measurement of air flows, and improvement of the pattern recognition of computers will be simulation tested with the help of the multiple-grid methodology.

The GMD research sites "Program Structures" at the University of Karlsruhe and "Innovative Computer Systems and Technology" at the Berlin Technical University also belong to the Institute for System Technology. With computers for the parallel processing of various problems, computation times are to be reduced considerably and error-tolerant computers will be developed. A HICOM digital extension system is being tested, a system in which all postal services converge through one circuit. The GMD is substantially involved in the development of the German Research Network, which is currently being presented to the public. In the area of base technologies, the GMD coordinates the cooperative project "Design of Integrated Circuits," in which 13 universities are collaborating. According to the long-term conceptions of the GMD, this area is to be expanded. In the area of fifth-generation computers, the prototype of a special computer that is especially suitable for the PROLOG programming language created for the use of "artificial intelligence" will be built this year at the Berlin research site.

Use of Computers in Planning and Management

After the computer support of routine office work, the Institute for Applied Information Technology of the GMD sees the central theme of the 1980's in the support of managers and planners. Part of the user knowledge is to be shifted to the system itself. Personal support systems, for example, are valid for planning problems of federal ministries, especially for the preparation of laws. An additional focal point includes group-support systems--electronic mail, computer-conference systems, and committee-support systems. The focus this year in the area of organization systems is a core system for the support of work in business and judicial offices. Expert systems are at the threshold of industrial use. In 1985, following such a system for the diagnosis of errors in the automatic transmission of an automobile, an additional expert system is to be developed for the automotive after-sales service.

THOMSON OF FRANCE PRESENTS PRELIMINARY 1984 RESULTS

'Near Equilibrium'

Paris LE MONDE in French 18 Apr 85 p 27

[Text] Thomson has nearly achieved equilibrium. After heavy losses in 1982 (2.2 billion francs) and 1983 (1.2 billion francs), the nationalized group finished last year with a consolidated deficit of "between zero and 50 million francs". Final results will be determined within the next few weeks. Its principal subsidiary, Thomson-CSF, posted a net profit of 300 million francs, compared to a loss of 811 million francs in 1983 and 2 billion francs in 1982.

Other signs of this "recovery": the Thomson group's gross self-financing margin was 2.4 billion francs in 1984, compared to 1 billion in 1983 and zero in 1982, while financial costs were stabilized at 3.2 percent of sales. The group had a good year in 1984, with a 15 percent increase in sales, which totaled 57 billion francs, and a 46 percent increase in orders (83.3 billion). Exports accounted for 61 percent of sales.

Mr Gomez, the group's CEO, is reaping the benefits of far-reaching organizational changes underway since 1982. The most important shift was the move away from the civil telecommunications sector, which bolstered CGE (all the same, Thomson still bears 180 million of the 450 million in losses sustained as a result of this activity in 1984). The medical division of the General Radiology Company (CGR) "is recovering", while the consumer division (TV, tape recorders, household appliances . . .) did not post as great a loss as the group feared it would at mid-year, thanks chiefly to Videocolor (TV tubes) which showed a profit.

The components sector, which grew 27 percent (5.1 billion in sales), also showed signs of financial recovery, while SODETEG remains a thorn in the group's side. Finally, the bulk of Thomson's profits were made in the arms trade, up 22 percent for a total of 19.7 billion francs.

Thomson Strategy

Paris LE MONDE in French 19 Apr 85 p 37

[Text] The Thomson-CSF firm is going to issue 3 billion francs worth of convertible bonds. The nationalized parent company Thomson will apply for approximately half of them in order to maintain its capital stake (50.4 percent). Around 800 million francs are expected to be borrowed on the French financial market and the remainder on the Swiss, West German and British markets. Exact subscription terms have not yet been determined, but the issue price should be around 600 francs a share. Mr Gomez, Thomson's CEO, who furnished this information when the group's nearly balanced statement was presented April 17 (le Monde, April 18), emphasized the value for his firm and for subcribers of recently adopted laws on "averaging" of previous losses. Thomson-CSF has in fact a 2.8 billion francs deficit accumulated in 1982 and 1983 which, "carried forward" to future statements, will reduce its taxes.

Furthermore, Mr Gomez indicated that CSF's "components" activities will be converted into a subsidiary at the end of next June. This sector, which was still showing undisclosed losses in 1984, is expected to "regain its equilibrium in 1986", despite the turnaround in the world market observed since the second half of last year, as a result of a productivity drive. The group's CEO did not deny that development in this "essential" sector is still a gamble.

In the area of consumer electronics (tied directly to the parent company), Gomez stated that his group "was going to retreat from the hi-fi market." After having jubilantly launched itself in this sector in 1983, the group was confronted with "the collapse of one-third of the French market," which upset its projections: "It was a failure." Around 300 of the 650 jobs in the Moulins factory where the stereo systems are manufactured are going to be eliminated with the cutbacks in production.

"Retreat" or surrender? Gomez declined to be more specific. The government is known to be divided on the question, which, two years ago, was a symbol of the recapture of the domestic market expected to follow nationalizations.

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BRIEFS

REVENUE AT THOMSON SEMICONDUCTORS--Since 1982, the structure of Thomson Semiconductors' sales is getting increasing closer to world market breakdowns, both by product families and by geographic zones. As far as the former are concerned, discrete components, for instance, represented 18 percent of the 1984 world market, compared with 82 percent for integrated circuits. In Thomson Semiconductors' sales ($300 million in 1984), discrete components accounted for 67 percent in 1982, 40 percent in 1983 and 35 percent in 1984. Same trend for MOS and bipolar integrated circuits: in 1984, MOS circuits represented 59 percent of the world market; at Thomson, they represented 40 percent of "integrated" sales in 1982, 53 percent in 1983 and 62 percent in 1984. As far as the MOS/C-MOS breakdown is concerned, Thomson is catching up: in 1984, the C-MOS market represented 25 percent of the world market for MOS+C-MOS. At Thomson, the C-MOS accounted for 5 percent of MOS+C-MOS sales in 1982, 12 percent in 1983 and 18 percent in 1984. As far as the geographic breakdown of sales is concerned, there is a marked recovery, but it is not yet halfway completed (so that all hopes are allowed concerning the possibility of increasing sales abroad): in 1984, France represented 3 percent of the world market, Europe 18 percent and the rest 82 percent. As for Thomson Semiconductors, it achieved 37 percent of its sales in France, 70 percent in Europe (including France) and 30 percent in the rest of the world. But in 1982 these proportions were respectively 62, 90 and 10 percent! [Text] [Paris ELECTRONIQUE ACTUALITES in French 22 Feb 85 p 21] 9294

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SCIENTIFIC AND INDUSTRIAL POLICY

EC TO EVALUATE FRG FUNDING OF RESEARCH PERSONNEL

Duesseldorf VDI NACHRICHTEN in German 1 Mar 85 p 6

[Article: "EEC Stops Federal Promotion of Research Personnel"]

[Text] The Federal Government's program for the promotion of research personnel in the economy is being examined by the EEC Commission for compatibility with EEC rules on competition. That means that promotion cannot begin until the examination is concluded in a few months. Affected are the new Personnel Growth Program of the Federal Ministry for Research and Technology and the extended Personnel Cost Subsidy Program (PKZ) in effect since 1979 of the Federal Finance Ministry. Both are supervised by the Working Group of Industrial Research Associations in Cologne, which is not now issuing any application documents.

In the case of the PKZ, it is reported that the EEC Commission is insisting upon a maximum duration of 6 years for individual assistance. To be sure, the growth program may be approved as a "remuneration of success," but in Brussels they are questioning whether 60 percent is not too high and the size of the enterprise class (up to 3,000 employees) is not too generous.

In recent years, the personnel costs subsidies for research and development personnel have become an important element of the Federal Government's overall research and technology concept. That follows from accompanying research by the Fraunhof Institute for System Technology and Innovation Research in Karlsruhe.

About 11,000 companies have taken advantage of the program since 1979. In 1983 alone, 7,869 applicants were included in the support. There is no promotion of developments for which customer orders have already been received. The enterprises assisted by the PKZ program in 1983 received an average subsidy of DM 51,391. The highest possible subsidy is DM 120,000. In 1984, budgetary appropriations of DM 320 million were available for the PKZ program.

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FRG RESEARCH EXPENDITURES, FUNDS RECIPIENTS, 1982-85

Duesseldorf VDI NACHRICHTEN in German 25 Jan 85 p 4

[Article: "1985 Research Expenditures Reach Record Levels"]

[Text] In 1985, federal research expenditures will amount to approximately DM 12.9 billion and will thus be 8.3 percent higher than in 1984. The research expenditures are distributed as follows:

Federal Research Expenditures (in billions of DM)

Ministry	1982 Actual	1983 Actual	1984 Estimated	1985 Ministerial Bill	Share in Percent for 1985
1. Research and Technology	6.86	6.49	7.00	7.16	55.5
2. Education and Science	0.92	0.99	1.01	1.01	7.9
3. Economics	1.26	0.96	0.89	1.32	10.2
4. Defense	1.70	1.86	1.96	2.34	18.2
5. Others	2.69	1.01	1.04	1.06	8.2
Total	13.43	10.31	11.90	12.89	100.0

The Ministry for Research and Technology administers 55.5 percent of federal research expenditures, the Ministry for Economics 10.2 percent, and the Defense Ministry 18.2 percent. If one considers only the area of civilian research expenditures, then they will amount to DM 10.6 billion in 1985, 68 percent of which will be administered by the Research Ministry.

In 1984, 43.3 percent of federal research expenditures, or DM 5.15 billion, were allocated to trade and industry for research projects and indirect promotional measures. The second-largest benefiting group is that of scientific organizations, which received 32 percent of federal research expenditures.

Distribution of Federal Research Expenditures By Recipient

Recipient	1982 Actual	1983 Actual	1984 Estimated
1. Federally owned installations	11.1	8.2	7.5
2. Installations of the Lands, municipalities and universities	7.5	8.8	8.8
3. Scientific organizations	28.4	31.6	32.0
4. Trade and industry	45.8	32.5	43.3
5. Foreign countries	7.2	7.9	8.4

Basic research and support for scientific organizations is a self-evident task of the state. In 1984, DM 2.6 billion went to the Federal Ministry for Research and Technology for the direct support of research projects in trade and industry. It is the declared intention of the Federal Government to reduce the direct project support in the civilian area of research assistance in trade and industry and to employ the indirect research-promotion measures as an instrument.

In looking at federal research expenditures, one should always consider that they account for only 23 percent of research expenditures in the FRG. Two-thirds of the German research capacity is in trade and industry and this sector finances almost 80 percent of its research expenditures itself.

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SWEDEN'S R&D EXPENDITURES FOR ADVANCED TECHNOLOGIES, 1973-1983

Stockholm NY TEKNIK in Swedish 14 Mar 85 p 38

[Article by Hans Werner]

[Text] Advanced technology will save Sweden's future as an industrial nation. This battle cry is heard time after time, especially from Swedish politicians from a broad spectrum of parties.

At the same time university researchers are making loud demands for more funds with which to pay scientists there. If these are not provided the universities will be drained of more and more teachers. They will go into industry.

What is industry investing in research and development (R&D)? The answer can be found in the latest SCB [Swedish Central Bureau of Statistics] survey of industry's technological and scientific R&D. It shows that throughout the 1970's industrial R&D costs rose but the increase was increasingly less rapid.

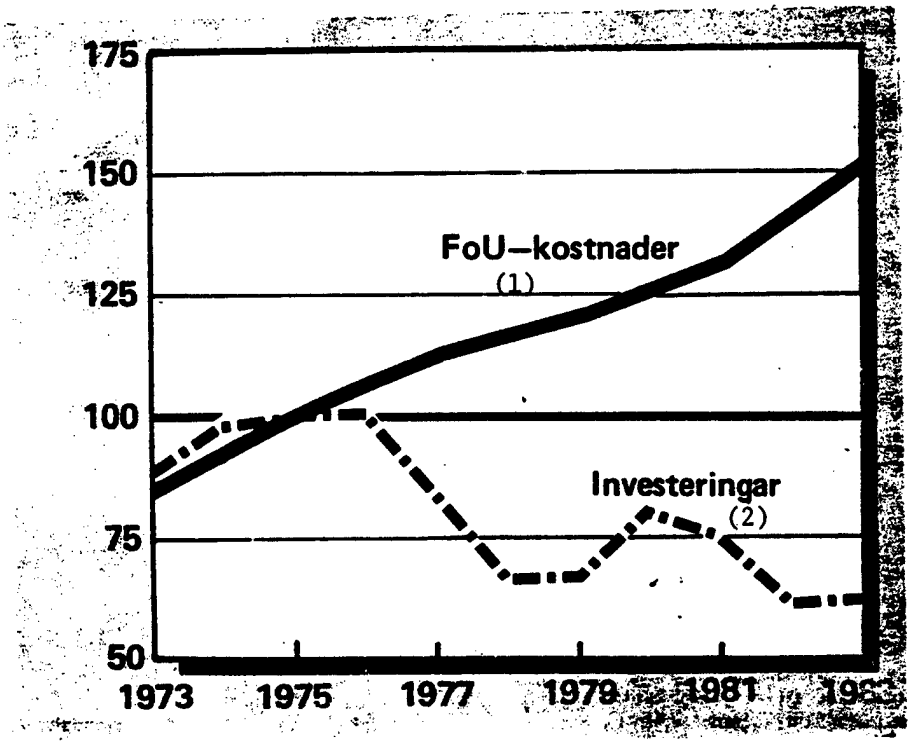
Upward since 1980

As a result of a sharp increase in the number of man-labor years between 1979 and 1981, this moderating trend was interrupted. In 1983 the number of man-labor years rose another 9 percent to 25,300. Forecasts that firms made to SCB for 1985 also indicate continued growth.

Industrial costs for R&D in 1983 were 9.8 billion kronor. That represents half the firms' investments in buildings and machinery in that year. Compared to 1981 this means an increase of 15 percent in R&D costs in fixed prices.

A total of 3 out of 100 workers employed in Swedish industries worked on R&D in 1983, the latest period studied. The figure is quite high in the international context.

But the fact is that industrial R&D investments are highly concentrated in a few firms and branches. With regard to R&D investments the five biggest firms account for more than a third of industry's total R&D.



Research and Development Costs Compared with Total Investments, 1973-1983. Index: 1975 = 100.

Key;

1. R&D costs
2. Investments

Firms Pay

Industrial firms in the machinery, electrical and transportation sectors account for more than 65 percent of industry's total R&D activity.

The firms themselves pay for around 90 percent of this. More than half the spending has been used to develop completely new products. Most of the rest of the R&D work consists of commissioned research for defense purposes.

The personnel cost percentage is declining. According to SCB this tendency began to show up at the end of the 1970's.

A large part of R&D costs went into drugs, machinery for the engineering industry, electrical products and means of transport. According to the figures for 1983 more than a quarter of the R&D money was spent on products that come within the electrical area.

Work Commissioned Abroad

Industrial costs for research work done outside a concern's own organization almost doubled between 1981 and 1983. In relation to R&D operating costs, commissioned work increased from 8 to 14 percent between the 2 years. This amounted to 1.2 billion kronor in 1983.

A very large increase, 102 percent in fixed prices, came in work commissioned abroad. In other words firms are shifting their R&D activity to other countries.

It is doubtful whether the newly-introduced tax breaks for foreign research workers performing temporary research tasks in Swedish industry will change this tendency in a more tangible way. We will have to wait and se..

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PHILIPS OF NETHERLANDS SEEKS FASTER INNOVATION APPLICATION

Rotterdam NRC HANDELSBLAD in Dutch 17 Apr 85 p 13

[Article: "Works Council: Innovation at Philips Could Be Quicker and Better"]

[Text] Eindhoven, 17 April -- Product innovation at Philips could be done more quickly and better. This is the most important conclusion of a memorandum drawn up by the central works council [COR] of the Philips companies in the Netherlands.

In the report, the COR expressed its concern about the quality of product innovation. Are there really enough ideas for new products, do we get on the market on time with the right products, are there obstructions on the way between idea and product." These are a number of the questions the central works council is asking itself.

According to the memorandum, the problems already start in the first phase of the innovation route where it is a question of turning ideas for new products into commercial plans. "In this respect it appears that Philips is usually stronger in technical ingenuity than in attention to the client," noted the report. "The result can be that a technically first rate product may still not become a market success.

Time Loss

The COR further noted that the decision to put a new product on the market is often preceded by a very complicated procedure. "In some cases the time loss involved is a decisive factor in the failure of a product innovation," wrote the COR.

A basic part of product innovation consists of process control. The memorandum pointed out that Philips has only a small number of experts at its disposal in this area. "Lack of knowledge is a weak link in the chain of product innovation," said the COR.

Paternalistic

In the report, the central works council drew up a balance of the strong and weak points of Philips. The memorandum lists technical know-how, the international structure, financial soundness and good management systems as plus points

for the enterprise. On the other hand, there is the cumbersomeness of the organization, and sometimes there is confusion about the goals of the enterprise. Workers are not adequately involved in setting goals and results. The style of management is sometimes plainly paternalistic.

In addition, according to the memorandum there is a lack of support at Philips for people who have strategic insight and dare to take risks. The result, said the COR, is that "in the existing situation the motivation of those involved, which is imperative for active innovation, is not always achieved." The quality of the work also plays a role here: work content, working conditions and participation.

Work Content

The memorandum makes a number of recommendations for improvements. The COR pleads, among other things, for the formation of project teams and improvement of internal communication. The committee also felt that the involvement of workers must be increased. This could be done by adding people from the shop floor to the innovation team in the design stage. This would result in greater insight into the feasibility of products. The work content of the workers should also be broadened through inspection, maintenance and repairs, so that a feeling of responsibility for quality will grow automatically.

In a first reaction to the report, General Manager F. van den Brand said that he applauds the fact that the COR, via the report, wants to broaden the workers' involvement. He did warn though that the shortcomings mentioned in the memorandum have been overstated. "We cannot jump on the backs of the large numbers of developers with a report that tells them that they are not doing anything with it. Because that is not true," stated Van den Brand. "The accent must lie on the observation that it could be better."

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SCIENTIFIC AND INDUSTRIAL POLICY

CONDITIONS FOR FUNDING FROM SWEDISH VENTURE CAPITAL SOURCES

Stockholm TEKNIK I TIDEN in Swedish No 5, 1984 p 8

[Article: "Industry Fund Has Venture Capital"]

[Text] About 100 technical development projects in Sweden are now supported by the Fund for Industrial Development--the so-called Industrial Fund--which was formed 5 years ago.

It was concern for the long-term development of Swedish industry that led to the establishment of the fund. Many feared that important technical development projects were not conducted simply because the industry lacked capital and there were no external sources of venture capital.

Today the situation is somewhat different. Swedish export companies are generating high profits and a well-developed venture capital market has developed.

Complement As Venture Bank

Nevertheless, the government wants to continue the fund. Its venture capital complements other sources of financing. In addition, the fund can help by analyzing projects and advising companies.

The fund has its own personnel, employs consultants, and has an excellent board of directors. This includes Torbjorn Ek of Hexagon, Sigvard Tomner of the Board for Technological Development, and Tor Ragnar Gerholm of the University of Stockholm. The executive vice-president of the Industrial Fund is Lennart Lubeck.

The groundrules for participation in the fund are as follows:

Only projects greater than 5 million kronor can be considered.

The upper limit for project support is 50 million kronor.

No more than half the project costs can be financed by the fund.

Support can be provided in the form of loans or subsidies, with the possibility

of writing off debts if the project fails commercially.

There is also another form of possible support. The fund can provide a king of project insurance by paying part of the costs of a project that fails.

Evaluation Of Market

The great majority of projects considered by the industrial fund are initiated by the companies themselves. These proposals lead to an evaluation of the market and of the technology. Another question considered is whether or not the project is totally dependent on support from the fund. In many cases, the companies can manage on their own.

The Industrial Fund does not provide support in the form of subsidized loans. The interest rate on loans is the discount rate plus 4 percent, which means that these are perfectly normal loan conditions.

Thus, does the Industrial Fund serve any purpose today, now that some of the conditions that led to establishment of the fund have changed, such as the growth of a venture capital market in Sweden?

Lennart Lubeck, executive vice-president of the Industrial Fund, said:

"The fund can play an important role in the future if it can function purely as a critical and independent project partner that is prepared to document its confidence in a risky development project by going in and sharing the risk with the company that has made a proposal."

"The shape this risk-sharing takes must then be adjusted to the project and to the needs of the individual company."

"Depending on the soundness, solvency, and type of project, loans may be most suitable, while royalty agreements or project insurance may be preferred in other cases," Lennart Lubeck said.

Last spring the industrial fund received additional capital of 600 million kronor from the government.

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FINLAND'S VALMET AUTOMATION FIRM FOCUSES ON SOVIET EXPORTS

Helsinki HELSINGIN SANOMAT in Finnish 23 Apr 85 p 31

[Article by Juhani Pekkala: "National Electronics Industry Did not Die with Finnvalco. Valmet's Automation Reaching for Millions"]

> [Text] Valmet's automation division has two alternatives: to expand into a sufficiently big international company in the field of process automation, or to specialize on some extremely narrow area and work its way from there to become the world market leader.
>
> The automation division and its director, Hans Andersin, Doctor of Technology, have chosen the first alternative. The choice will inevitably lead into the fact that the turnover of the automation group will have to increase sixfold before the year 1995. However, specialization will not be completely forsaken.

"When I came to lead the automation division in 1978, we set as a goal that the turnover will be one billion marks during the second half of the 1980's. The goal will be reached this year. Now we have come to the conclusion that the turnover should actually be one billion dollars; only then would we be internationally big enough to deliver process automation," says Andersin.

It is irony of history that Dr Andersin was in favor of closing Finnvalco in 1980.

However, now Andersin has created an automation division with enormous growth within Valmet. This year the division's turnover will already reach 16 percent of the turnover of the whole concern.

The automation division is the only part of Valmet which is operating in a fast growing sector. Shipyards, tractors, paper machines, forest- and other machines are fighting for a share in mature markets.

The current significance of the group within Valmet is also emphasized by the fact that Hans Andersin is the only director of an operational sector who is a member of the board of directors of the corporation.

Losses as an Exception

Last year, as an exception, the automation division was the weakest of all Valmet. The explanation concerns Dava and its losses. Since the beginning of this month Dava has a new managing director. Anders Kranck was replaced by Christian Westerlund of Nokia. Kranck became the managing director of Facit.

One reason for Dava's weak year was the poor sales of the Ericsson personal computer. Dava's plans were disrupted by the fact that Ericsson computers were not compatible with IBM. In the field of computers, the fact remains that nobody can afford to market a computer which is not compatible with the equipment of IBM. Among others Dava ended up with piles of Ericsson computers in stock.

Dava has been divided into many different parts. Dava Instituutti Oy and Dava Rentals Oy have been separated from the company. Oy Facit Ab and Oy Edacom Ab also belong to Dava.

Andersin reminds us that the profitability of the division has not always been poor. A couple of years ago the division grew rapidly but it was profitable at the same time. "During the growth it is not possible to obtain large profits, but one should not allow losses, either. However, investments on the U.S. markets, for example, do not bring immediate profits," Andersin says.

"Failures are part of the nature of this business. They have to be considered as part of the investment. It is unfortunate, of course, but realistic."

It sounds amazing that a distressed corporation has the courage to develop in risk-prone electronics and automation industries. Andersin's answer to that is: "Fortunately we have not erred too badly yet. With technological excellence we can do well and the market is growing all the time."

Free Division

The position of the automation division of Valmet has been free; it has not been subject to restrictions or limitations. So far Valmet has been able to support financially. Risk capital from outside has not yet been necessary.

The division's operations have been restricted financially only in that it has not been able to buy "the 100-million dollar" enterprise which would have solved the problems all at once.

"Our problems are not in financing, they are in marketing, research and product development."

The group creates its projected growth through acquisitions. "There are always companies for sale; sure there are," assures Andersin.

"Of course we will not buy a company similar to ours. The areas that we know we will develop ourselves. But we went in with Roibox for instance, because it makes sensors suitable to our process control systems."

"Our acquisitions are concentrated in the United States. Europe and the Nordic countries. A company that we would acquire has to have good domestic markets, high technological level and a developed environment."

"In this job cheap labor does not help. The total price of the project is decisive, since Valmet delivers large turnkey projects." Andersin talks about acquisitions as if they were commonplace, everyday things. Andersin, who--among other things--has been professor of data processing at the School of Technology, does not embellish his message with English-language expressions.

Nevertheless, Andersin is a director who has visions about the future, sometimes quite daring visions. He likes to communicate frequently with American financiers and men of the same field. This man has time also for other things besides directing Valmet's automation division.

New Directions

Valmet's automation division consists of two large units; one is process automation and the other Dava enterprises. Timo Talvinen is responsible for process automation and Christian Westerlund for Dava enterprises.

The division also comprises Mittaritehdas [meter plant], which manufactures energy meters, and Valmet Data Systems, which supplies series of programs. The group has the total of 25 profit centers which can operate independently. "The management of this kind of operation cannot be too centralized," says Andersin.

At the beginning of this year, a new Valmet Automation Projects Ltd was established within the division. It specializes in Soviet trade. It collects the division's data and know-how into projects. Earlier, Dava had similar activities.

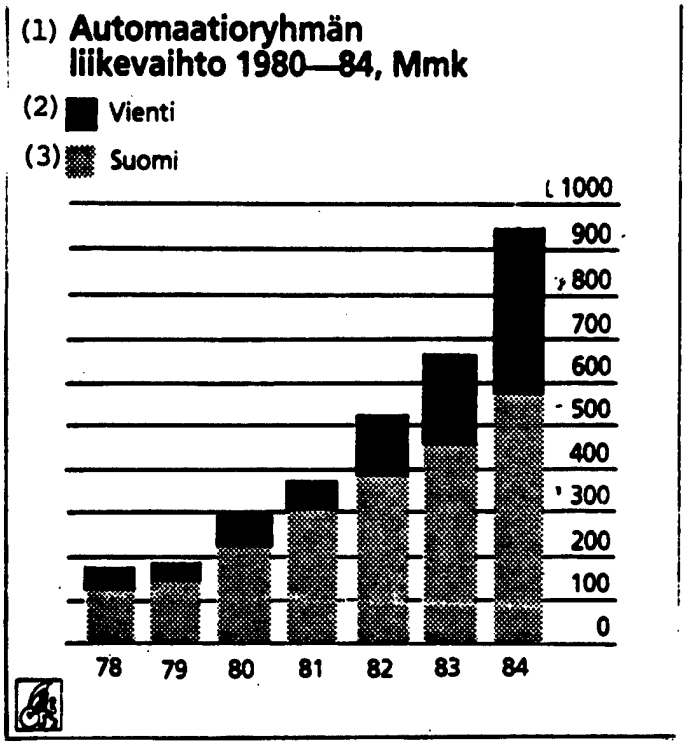
At the moment Andersin considers the structure of the division suitable, but the field changes rapidly, more rapidly than the people. "The growth rate sometimes seems a burden to people, but you have to hang on, otherwise you will be left behind."

The automation division has been able to focus its operation more and more clearly. It has concentrated on areas on which the corporation already has experience: ship automation, process automation, and particularly on wood-processing industry's processes.

In ship automation the corporation was the first to create a system in which all ship's operations have been combined in the same system. Over 30 systems have already been sold, but mainly to the Far East.

An example of process automation is pulp mass density meters. Valmet has an almost 50-percent market share of the world's pulp density meters. "An example of having been specialized almost on the eye of the fly."

One of the new products of the division is an electronic energy meter which replaces the old mechanical kilowatt-hour meter. Americans and the Japanese have contributed to its development. Big electronics companies were not interested in developing them, but they are interested in licences.



Key:
1. Turnover of automation division 1980-1984, million markkas
2. Exports
3. Finland

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